Important Talking Points - Instructor

* Transition from 1x3% AR-AFFF to NF Universal F3 Green 3% AR-SFFF
* Foam quality (expanded 5-10:1) is now critical to firefighting performance.
* Physical Appearance - close to the same as Thunderstorm AR-AFFF.
* Proportioning (mixing) concentrate and water, 3% - No more 1% option.
* Foam Eductors: no electronics, completely mechanical; rely on water power.
* Self-inducting monitor nozzles; foam trailer items.

Quiz

1. Does class A training foam solution contain PFAS ___
2. How many square feet of fire will a 125 gpm foam stream handle _____
   math : Univ. Green 3% 0.16 gpm ÷ 125
3. Foam eductor inlet pressure is _____ psi
4. How much back back pressure can a 200 psi eductor stand ___ (use 65 % inlet pressure rule)
5. What is reach of a 125 gpm foam stream +/-_____
6. What is reach of a 500 gpm foam stream (foam trailer) +/-____ ft.
7. What is reach of a 1000 gpm foam stream (foam trailer) +/- ___ ft.
8. Solution transit time in 200 ft. 1.75 hose at 125 gpm +/- ___ sec.
9. Solution transit time in 200 ft. 3' hose at 350 gpm +/- ___ sec.
10. Is Blitzfire nozzle set in red or blue setting when fed by 350 eductor _____
11. If pressure loss in 5" hose at 1000 gpm is 5 psi, what is it at 1500 gpm (rule of 4)
12. If friction loss in1.75" hose is 15 psi at 100 gpm what will it be 200 gpm _____
13. Will Go-Gauge go to red scale when nozzle is closed _____

Foam Eductors

Reliable

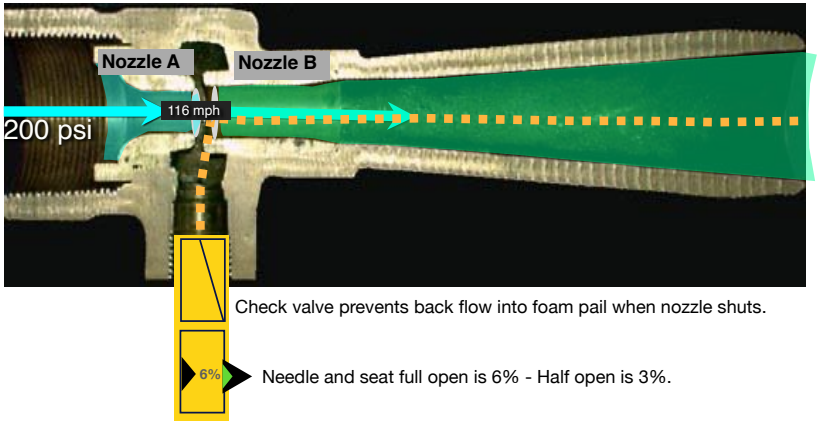
Rugged

No Moving Parts

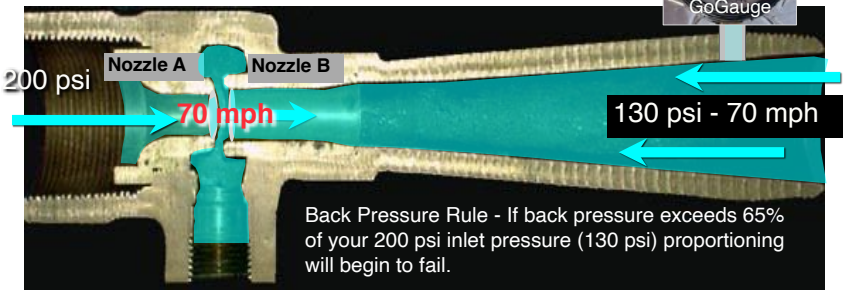
Inexpensive

How a foam eductor works (jet pump)

Smoothbore nozzle A discharges into nozzle B at 200 psi (116 mph) causing concentrate to be drawn into the low pressure area created by a venturi effect.



Eductors fail when they see back-pressure caused by discharge restrictions. A partly closed nozzle, hose too long, too small or excessive nozzle elevation will cause vacuum reduction. Too much reduction and proportioning will stop.



Hose friction loss, nozzle pressure and nozzle elevation determine back pressure. A 100 psi nozzle + 30 psi friction loss in 200 ft. 1.75" hose is all this 95 gpm system can stand. If nozzle pressure is 75 psi one can add about 100 ft. of 1.75' hose. If 2" hose were used you can double the hose distance to the nozzle making total allowable distance with a 75 psi nozzle, 650 ft.

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Application Rate

Ignited fuels consume finished foam as a result of heat consumption and being carried away by wind or fire draft.

As long as finished foam application is greater than its consumption you are likely to win the battle.

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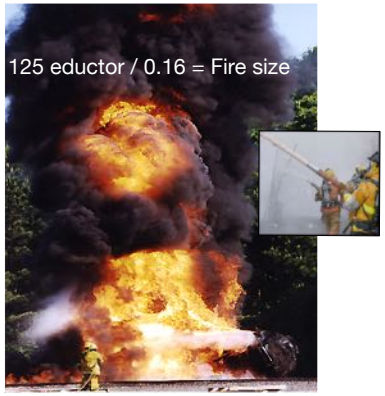
Application Rate

Divide foam solution flow rate by 0.16 for AR-SFFF



A 125 GPM AR-SFFF foam stream should extinguish a +/-800 square foot diesel or E-10 gasoline spill.

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Application Rate

Class B - Polar Solvents

A 250 gpm AR-AFFF foam stream should extinguish a 1000 square foot acetone or IPA spill.

Notice: Alcohol (solvent fuel) application rates vary by manufacturer. Check with your foam concentrate supplier for specific fuel listings, approvals and application rates.

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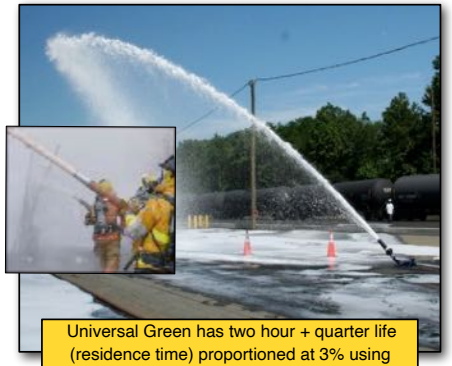
No application rate for unignited spills.

Maintain a 3 to 4 inch foam blanket. Monitor with meter. Reapply when odor returns or meter shows dangerous concentrations



Universal Green has two hour + quarter life (residence time) proportioned at 3% using fresh water at 10:1 expansion

Do not to plunge stream into a spill - It may send atomized fuel on to exposures or to ignition source.

Foam Expansion Ratio

One gallon of solution aerated ten times is a 10:1 ratio.
Low expansion, 7 to 10:1 is preferred for reach and extinguishment. Preferred for Universal F3 Green.

Medium expansion (mid-x) class B foam is preferred for spill vapor control. Mid-x is from 15 - 30:1 expansion.

Vapor Suppression

Apply Aerated SFFF Foam

Firefighters working in and around high vapor pressure haz-mat spills should apply aerated AR-SFFF foam.

Reapply foam at the foam's quarter life. Universal F3 Green will go +/- two hours at 10:1 expansion with fresh water.

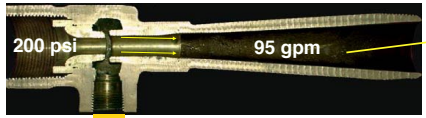
Use gas meter to determine foam application frequency - If fuel odor returns foam it…

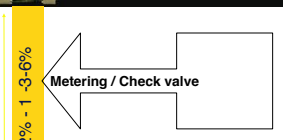
Foam Eductor Must Be A Hydraulic Match For The Nozzle

125 GPM setting and higher is OK for 95 gpm eductor, although stream velocity will be reduced.

Take away nozzle and fill a tank with solution 800 ft. away from eductor with 10 psi outlet pressure. (less back pressure is good for eductor)

60 GPM setting will shut down a 95 gpm eductor - too much back pressure.





1/2% - 1 -3-6%

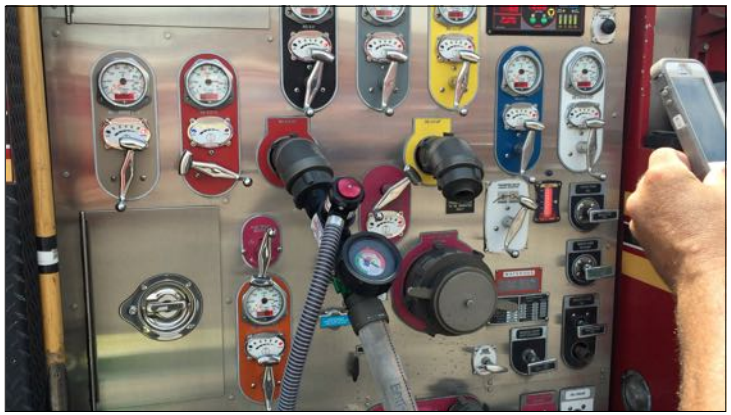
Foam concentrate supply

Managing Back Pressure

Back Pressure < 130 psi

N P 75 psi
Elevation 37 psi
Plumbing 3 psi
Total BP 114 psi

Go-Gauge



400 ft. 1.75” hose to a 75 psi nozzle - doable in **green**

500 ft. 1.75” hose to a 75 psi nozzle - not doable in **red**

Simple system alternative for future fleet consideration.

- **Eductor connects to foam tank valve.**
- **Big fire big eductor.**
- **Fill and drain tank from panel connection.**

Transit Time

The time it takes for foam to arrive at nozzle

Always start foam ops. with dry lines. Put eductor pick-up tube in the pail first - connect 200 ft. hose and charge line … at 100 psi. Once solution reaches nozzle throttle-up to 200 psi.

If hose-line is first filled with water, it will take transit time for foam solution to arrive at the nozzle after foam concentrate is introduced. The delay could be embarrassing.

1.75" hose flowing 95 gpm 9 sec. / 100 ft.

1.75" hose flowing 125 gpm 7 sec. / 100 ft.

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Handout

Foam Lines

National Foam

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Portable Foam Eductors - The inexpensive, bullet-proof alternative.

A simple, inexpensive foam eductor or self inducting master stream nozzle is an accurate, bullet-proof alternative to complex and often maintenance intensive multi-discharge foam firefighting systems. Eductors have no moving parts, no flow meter interfaces, pumps, motors or electrical requirements. Foam eductors can work within UL accuracy with all known fire fighting foams, wetting agents and specialty chemicals - as long as a the first commandment of foam eductor operations is not broken.

"Thou shalt not have too much back pressure, lest ye don't make foam"

Basically, a foam eductor is a jet pump which relies on a high-speed water jet to provide suction energy

This foam eductor cross section shows two nozzles aligned front to back in a common space. As water passes from nozzle A to nozzle B it jumps across a narrow gap causing a strong suction effect. The gap is vented by way of casting or machined space to the pick-up tube inlet, C. As long as water speed across the inner nozzle gap does not slow below 65% of inlet pressure it will continue to draft foam concentrate into the stream, creating a foam/water solution.

Self-Flushing eductor designed for very viscous alcohol type foams.

If discharge is interrupted at the outlet of the eductor (D), a check valve will prevent water back-flow through the gap, into the pickup hose and on to the foam concentrate supply.

At the pickup tube connection (C) there is often an adjustable choke (meter) and check valve. When the choke is wide open, proportioning rate is 6%, which is 94 parts water and 6 parts foam concentrate, a 94:6 ratio. When half open it proportions 3%, a 97:3 ratio. Modern fire service eductors have metering capability from 1/4% through 6%, accommodating both class A and B foams.

65% Velocity Rule

When operating a fire service foam eductor at 200 psi, water velocity at the inlet smoothbore (A) is 116 mph. If eductor discharge (D) is slowed by a partly closed nozzle, too long or a kinked hose can causes water flow across the gap to slow. Too slow is 130 psi (70 mph) - the eductor begins to stops drafting.

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Handout

The first commandment of foam eductor operations was the inspiration for Combat Support Product's, GoGauge®. This gauge, when screwed on an eductor's outlet will indicate downstream back pressure. When it reaches the red zone one can expect foam induction to stop. If the hose is too long, the wrong size or nozzle flow setting too low, the GoGauge® says so. This addition makes eductor operations pretty much a no brainer.

Eductor Flow Rate

What determines eductor flow is the eductor's inlet nozzle diameter. In the case of a fire service-type foam eductor as seen in figure 1 on the previous page, the inlet nozzle of the 95 gpm eductor pictured is slightly less than 1/2 inch. A 125 gpm eductor has a slightly larger smoothbore, and 350 gpm eductor has an inlet nozzle slightly less than one inch (0.90").

Examples of the 65% rule using the figure 1 eductor, set for 3% at various inlet pressures.

100 psi inlet - 65 psi is allowable outlet back pressure (nozzle plus hose and elevation losses). At 100 psi, this eductor inlet nozzle (A) will flow will flow 67 gpm and proportion at near 4%.

150 psi inlet - 97 psi is allowable outlet back pressure (nozzle plus hose and elevation losses). At 150 psi, this eductor inlet nozzle (A) will flow will flow 87 gpm and proportion a little rich.

200 psi inlet - 130 psi is allowable outlet back pressure (nozzle plus hose and elevation losses) At 200 psi, this eductor inlet nozzle (A) will flow will flow 95 gpm and proportion accurately.

250 psi inlet - 163 psi is allowable outlet back pressure (nozzle plus hose and elevation losses). At 250 psi, this eductor inlet nozzle (A) will flow will flow 106 gpm and proportion a little lean.

Using the 65% rule, distance from a 95 gpm eductor to a foam nozzle is a function of the back pressure. Fire ground hydraulics dictates that a 95 gpm foam stream will flow through 200 ft. of 1.75" hose with a 100 psi nozzle when 130 psi is at the supply end of the hose. If using a 75 psi nozzle, the pressure requirement is 105 psi. Remember, these pressures would register as back pressure on the GoGauge®. If using 2" hose, the distance could double, because 2" hose has half the friction loss of 1.75".

In the case of a 350 gpm eductor, the rule is the same. Therefore, a dismounted deck gun with a 75 psi nozzle, using 2.5" hose can be fed 100 ft.; with 3", 400 ft; with 4", 2200 ft, and 5" … 7300 ft.

Without a nozzle the discharge hose can be used to fill a folding tank or an engine's water tank. The distance from eductor outlet to the fill site using 1.75" hose would be near 850 ft. Using 2" hose it would be 1700 ft.; using 2.5" hose it is 5200 ft. This is because nozzle pressure isn't needed at the fill site.

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Handout

Foam Eductor Operation Pointers

Solution Transit Time

Transit time is the time it takes foam solution to get from eductor outlet to nozzle inlet. With 200 ft of 1.75" hose, at 95 gpm, it will take about 18 seconds. A 60-gpm eductor can take as much as thirty seconds for the solution to get to a nozzle. The larger the hose, the longer it will take. This is true for on-board foam system too. So, whatever setting changes you make, it will take half a minute or more before you notice change at the nozzle. Never charge the hose with water before putting tube in the pail.

Eductor Start-Up Steps.

1. Connect eductor to a convenient discharge.There is no technical reason to have eductor in a hose line other than extending distance when long stretches are needed. Never throttle eductor supply discharge, use pump speed throttle.
2. Put pick-up hose in foam pail or connect it to an onboard foam tank eductor connection.
3. At idle, fully open discharge and fill hose with solution. It works at idle pressure because the eductor feels no back pressure... Remember, You are discharging into an empty hose.
4. Once hose line is full, throttle to 200 psi.

No transit time issues if done in this order. The nozzle will have solution ready to go when operator opens the bale.

Proportioning Accuracy - A Major Safety Issue At Crash Scenes

Just because you're making bubbles does not mean they will have enough weight and body to hold down gasoline vapors on a hot road spill. Industry standards allow proportioning as much as one full percent rich, no lean. Lean proportioning means lightweight foam and fires may not go out as fast as you want, if at all. Lean means finished foam disappears (drains) way too fast while trying to maintain vapor security at crash scenes. **Caution: Never use class A foam for this task.**

During the summer, unignited road spills can get very hot, resulting in dangerously high vapor pressure. **Here is where I proportion 3% foam at 6%.** Doubling up on concentrate should double your foam staying power (quarter life), which uses half the water.

Since foam concentrate viscosities vary from type to type it would be wise to test all your eductors for accuracy. AR-AFFF's (ATC's) are the most viscous. My experience with older foam eductors and AR-AFFF has not been good, they tend too be lean. Proportioning accuracy can be tested using water. **Remove pick-up tube strainers before testing.** Equivalency numbers for Universal Gold is 15%. Your eductor will drink +/- 15% less foam concentrate than water. How to test is at www.CombatSupportProducts.com.

Flushing

After making foam, put the pick-up tube in fresh water and flush for a minute. If using a TFT push-button flush foam eductor - shut the nozzle, or cap the eductor; set pump pressure less than < 50 psi and press the red button for a few seconds. If necessary, throttle the discharge gate to get pressure low enough to press the button.

Eductor on pump discharge, not 50' down the street... Try it!

Long term vapor suppression require properly proportioned solution.

CombatSupportProducts.com FoamChariot®

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Engine Company Eductor Procedure

95 GPM EDUCTOR

1. Insure machine is safely in pump gear. If possible upgrade - upwind from spill.
2. Connect eductor to pump discharge - set 3% - get foam pail wrench ready.
3. Put pickup tube in fom pail.
4. Connect no more than 200 ft. 1.75" (1200 ft. 2.5") hose to eductor. - chase kinks.
5. Attach foam nozzle - aim away from fire.
6. Charge dry foam line at **100 psi**.
7. When line is completely charged with foam solution, bring pressure to **200** psi
8. Nozzle opens for five count insure patent foam stream, bring to bear on target.

DO NOT PLUNGE STREAM INTO FUEL SPILL

Notes: Five gallon foam concentrate will drain at about 3.75 gallons per minute. Have more at the ready.

There is about 20 seconds of solution in hose-line when last pail is spent. Will take 20 seconds to refill with solution if water replaces foam solution. Any changes at engine will take about 20 seconds to be realized at nozzle.

Flush with engine off hydrant. Flush hose, nozzle and eductor at **50 psi** with tank water.

With eductor hose out of pail or % selector "OFF", flow nozzle and hose until frothing stops.

Hose out of pail, nozzle shut, eductor set at 3% press **red flush button** for five seconds at **50 psi.**

Warning! Concetrate will be slip hazard around spills and or eductor flushing.

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Placing 350 GPM Eductor In Service

Connect no more than 300 ft. 3" or 150 ft. 2.5" discharge hose to eductor. Nozzle set in RED, low pressure position.

Set eductor to 3 %. With foam supply valve to eductor open, slowly open water valve. Maintain pressure at 190-200 psi.

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Hydraulic rule of four - If flow doubles, pressure loss increases four times.

Need To Know

1.75" hose loose 15 psi at 100gpm per 100 ft.
1.75" hose loose 30 psi at 150 gpm per 100 ft.
1.75" hose loose 60 psi at 200 gpm per 100 ft.
5" hose loose 1.25 psi/100' at 500 gpm
5" hose loose 2.5 psi/100' at 750 gpm
5" hose loose 5 psi/100' at 1000 gpm
5" hose loose 20 psi/100' at 2000 gpm
3.5" intake valve looses 6 psi at 1000 gpm
3.5" intake valve looses 24 psi at 2000 gpm
X monitor looses 5 psi at 1000 gpm
X monitor looses 20 psi at 2000 gpm

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Hydraulic Profiles - Foam Eductor - AR-SFFF Universal F3 Green 3% - Muni Green F3 Plus 3%

	Eductor Or Solution Flow GPM	Fuel Spill Or Over The Top Tank Fire Type III	Fire Control Size Sq. Ft. UL 162 AR-SFFF 0.16	3% Concentrate Flow GPM	Nozzle Pres Or Hose Outlet PSI	Distance FT Hose ID 1.75	Distance FT Hose ID 2.0	Distance FT Hose ID 2.5	Distance FT Hose ID 3	Distance FT Hose ID 4	Distance FT Hose ID 5	Distance FT Hose ID 6
Fairfax County	95	Crude, Diesel, E10	594	2.85	100	200	350	1,200				
	95	E15	432	2.85	75	350	650	2,200				
	95	Ethanol	950	2.85	50	500	1000	3,200				
		1.75" Transit 10 ft./sec.			10	800	1500	4,800				
	125	Crude, Diesel, E10	833	3.75	100	100	250	800				
	125	E15	568	3.75	75	200	450	1,450				
	125	Ethanol	1,250	3.75	50	300	650	2,100				
		1.75" Transit 7 ft./sec.			10	500	1000	3,200				
	250	Crude, Diesel, E10	1,563	7.5	100		200	450	3,000	6,000	12,000	
	250	E15	1,136	7.5	75		350	850	5,500	11,000	22,000	
	250	Ethanol	2,500	7.5	50		500	1,250	8,000	16,000	32,000	
		2.5" Transit 10 ft./sec.			10		800	1,900	12,000	24,000	48,000	
Fairfax County	350	Crude, Diesel, E10	2,188	10.5	100		150	300	1,200	4,000	8,000	
	350	E15	1,591	10.5	75		150	400	2,200	7,300	14,600	
	350	Ethanol	3,500	10.5	50		250	600	3,200	10,600	21,200	
		3" Transit 7 ft./sec.			10		300	950	4,800	16,000	32,000	
	500	Crude Diesel & E10	3,125	15	100		50	100	600	2,000	4,000	
	500	E- 15	2,273	15	75		100	200	1,100	3,600	7,200	
	500	Ethanol	5,000	15	50		100	300	1,600	5,300	10,600	
					10		200	450	2,400	8,000	16,000	

Universal Green 3% fresh water. Foam residence time (¼ life) at 7-10:1 is 2+ hrs. Half for salt water.

MuniGreen + 3% fresh water. Foam residence time (¼ life) at 7-10:1 is +/- 1.5+ hrs. Half for salt water.

reapply foam when odor returns or instruments alert

Eductor back pressure indicator. If red while nozzle open there's kinked hose, hose too long, nozzle throttled or hose diameter too small per this chart.

NFPA 11 requires fifteen minute foam / water supply for spill firefighting
NFPA 11 requires 65 minute foam/water supply for tank firefighting
Application rates the same for spills and tank fires 0.16 gpm sq. ft. For hydrocarbons. See mfg. app rate for polar solvents.
Eductor operations: 200 psi inlet pressure do not exceed 65% of inlet pressure,130 psi as back pressure. See Go-Gauge
Distances above are based on NFPA Friction loss tables and or field experience. © 2023 Cottrell Associates, Inc.

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Application Rate Master Streams

How much fire can a master stream nozzle handle? - **U-Green 3%**

250 gpm will cover a 1,526 sq.ft. hydrocarbon (fuel oil) spill. 110 ft. reach

500 gpm will cover a 3,125 sq.ft. (fuel oil) spill. 125-150 ft. reach

750 gpm will cover a 4,678 sq.ft. fuel oil spill. 170-180 ft. reach

1000 gpm will cover a 6,250 sq.ft. fuel oil spill. 190-200 ft. reach

1500 gpm will cover a 9,375 sq.ft. fuel oil tank. 220-240 ft. reach

2000 gpm will cover a 12,500 sq.ft. fuel oil tank. 230 -290 ft. reach

3000 gpm will cover a 18,750 sq.ft. fuel oil tank. 300 -325 ft. reach

Half the area for Ethanol

Self-Priming Transfer Pump Kit

Made for very viscous liquids.

Fills a 330 galon tank in +/- 15 minutes

VIDEO

Always fill foam tanks from bottom-up. Use stingers (dip tubes) on both tanks if necessary; preventing messy, frothing over-flows. Same for engine tanks.

Flushing Hose, Nozzle and Eductor

1. Make flush pressure 100 psi. Flush hose and nozzle with foam pickup tube out of foam container; flow until discharge froth stops.
2. Remove nozzle and hose.
3. Make pressure < 50 psi. Draw clean water from a wash bucket through all eductor meter (%) settings till frothing stops.

Flushing TFT Eductors

Flush Hose And Nozzle

1. Lower pressure to 100 psi.
2. Set eductor meter to 'OFF'.
3. Flow nozzle till frothing stops.

Flush Eductor At 50 psi.

1. Use tank water. Hydrant supply off.
2. Lower pressure to 50 psi.
3. Set meter to 3%.
4. Hold red flush button down until frothing stops.

How Much Concentrate & Water Will You Need?

Spill Fire: Defined as one to two-inches or less in depth.

NFPA 11 requires you have enough foam concentrate and water on hand for a fifteen minute spill operation. About twice the burn rate time.

A 100 gpm, 3% stream will use three gallons of concentrate per minute. In fifteen minutes you will consume forty-five gallons of 3% concentrate. You will also consume 1,455 gallons of water.

A 1000 gpm, 3% stream will use 30 gallons of concentrate per minute. In fifteen minutes you will consume 450 gallons of 3% concentrate. You will also consume 43,650 gallons of water.

Determine water used by multiplying concentrate used by 97